CHAPTER 4.2 WATER QUALITY ASSESSMENT SUMMARY

The overall water quality for Virginia is assessed based on whether the condition of the waterbody being assessed allows citizens to safely enjoy its designated uses as described in Virginia's water quality standards. Table 4.2-1 briefly describes the primary designated uses and the parameters used in this assessment to demonstrate their attainment. Several additional aquatic life sub-uses have been adopted for the Chesapeake Bay and the tidal tributaries. Additional information about the Bay sub-uses can be found in Chapter 4.4.

Table 4.2-1 Designated use descriptions and indicators

DESIGNATED USE	USE DESCRIPTION/INDICATORS
Aquatic Life Use, Chesapeake Bay sub-uses	Description: The propagation, growth, and protection of a balanced indigenous population of aquatic life that may be expected to inhabit a waterbody
	Indicators: Dissolved oxygen, pH, temperature, chlorophyll a, nutrients, water column and sediment toxics, toxicity tests, benthics, submerged aquatic vegetation
Fish Consumption Use	Description: Game and marketable fish species that are safe for human health
	Indicators: VDH notices, fish tissue toxics, water column toxics
Shellfishing Use	Description: Marketable shellfish (clams, oysters, mussels) that are safe for human health
	Indicators: VDH notices
Recreation (Swimming) Use	Description: Swimming, boating, and other recreational activities
	Indicators: VDH notices, bacteria
Public Water Supply Use	Description: Drinking water safe for human health
	Indicators: VDH notices, water column toxics
Wildlife Use	Description: The propagation, growth, and protection of associated wildlife
	Indicators: Water column toxics

The six-year assessment begins with an analysis of all quality assurance/quality control (QA/QC) approved data from DEQ ambient water quality, biological, sediment and fish tissue monitoring, special studies and/or other non-DEQ water quality data, including citizen monitoring data. Non-agency monitoring data is evaluated for use in the assessment using a process outlined in Part VI, Section 6.3.1 of the 2012 Assessment Guidance Manual. The results of these comprehensive data analyses are compared to both numeric and narrative criteria related to the designated uses established by Virginia's water quality standards, which are provisions of state and/or federal regulations. A description of the assessment methodology can be found in Chapter 4.1, as well as the 2012 Assessment Guidance Manual.

Statewide summaries of the river miles, estuarine square miles, and lake/reservoir acres within and bordering Virginia are presented in Tables 4.2-2 through 4.2-4. The overall assessment of each waterbody was determined by examining the support of up to six designated uses (see Figure 4.2-1), as appropriate, for each assessed waterbody. The assessment of a specific use depends on the types of data that are available. Additionally, not all uses may exist in a given water. For instance, the public

water supply use only applies to the waters designated in Virginia's water quality standards. The shellfishing use only exists in estuarine waters.

Additional geographical re-indexing and use of the National Hydrologic Database (NHD) has slightly altered the actual number of stream miles within the state from previous reports. The stream mile delineation guidance has provided basic guidelines to the regional assessment staff for associating the mileage assessed, relative to a specific sampling station. This is especially important where there are no easily identifiable changes in watershed characteristics. In some cases, the stream miles associated with a sampling station have been conservatively reduced or in other cases, slightly expanded from previous assessment reports. In many cases, additional monitoring stations have been added in the watershed and may increase the size of some impaired segments depending on the additional data collected and assessed. The stream mile delineations found in this report are only reflective of the 2012 assessment period but follow closely with the monitoring efforts reported in previous reports.

The total size of estuarine waters is approximately 2,684 square miles for the 2012 report. This is an increase over past estimates, due to the inclusion of some small coastal zones that were sampled by DEQ in 2010. A total of 116,364 reservoir/lake acres was determined to be available for assessment this cycle. This increase reflects the on-going refinement to DEQ's Geographic Information System (GIS) tools.

Results

Tables 4.2-5 and 4.2-6 lists the major causes and sources of impairment for those waters not attaining full support for at least one designated use. Impairment causes and/or sources can be a "major impact", defined as that which causes a significant impairment to the waterbody, or moderate and minor impacts individually or in combination. Normally a major impact would be from a sole source with a large pollutant(s) contribution. Moderate and/or minor impacts have a slight to moderate effect on the waters and may be from a single moderate contributor or a combination of several minor contributors. It is important to note that moderate and minor impacts can, under certain conditions, work in conjunction to cause a major impact. Assessors take into consideration such factors as land use and co-occurring impairments when determining likely sources of pollution for a particular water.

One major cause of impairment of the aquatic life use is low dissolved oxygen concentration. All aquatic life depends on oxygen, and when it is depleted to the point where aquatic life is no longer sustainable, a water is said to be hypoxic. Hypoxia can result from natural processes, such as in slow-moving swamp waters that have large amounts of decaying plant material. It can also naturally occur in lakes/reservoirs when the water column becomes thermally stratified. However, chronic hypoxia often occurs for anthropogenic reasons. Nutrient pollution can cause hypoxia by promoting the growth of algae blooms. Excessive algae produce floating mats on the water surface which keep light from reaching rooted vegetation, therefore limiting its growth. Moreover, as algae die and settle to the bottom, decay processes reduce oxygen levels and create unfavorable conditions for other aquatic organisms. Fish kills often result from hypoxic conditions. Stormwater runoff, which often carries lawn/agricultural fertilizers and nutrient-rich animal wastes, is a major contributor of nitrogen and phosphorus pollution.

The major cause of impairment of the recreation and shellfishing uses is excessive bacteria. *Escherichia coli* (*E. coli*) is the pathogenic indicator used in freshwater, while enterococci is used in estuarine/coastal waters. These bacteria are associated with the fecal matter of warm-blooded animals. Bacteria and other microorganisms are found naturally in water, but can become harmful to human health in high concentrations. Exposure to water-borne pathogens can cause various gastrointestinal, skin, neurological, and other serious diseases. Stormwater runoff often carries domestic and livestock animal wastes, and it is a major source of impairment. Inadequate sewerage and combined sewer overflows are other major sources.

Mercury and polychlorinated biphenyls (PCBs) are the major causes of impairment of the fish

consumption and public water supply uses. Mercury, specifically in the form of methylmercury, causes damage to the human central nervous system and brain. The metal can be found naturally, but its appearance in the environment is often due to anthropogenic reasons. Mercury commonly enters water through atmospheric deposition. Air particles can travel vast distances, so locating a single source is not possible in most cases. Some anthropogenic sources of atmospheric mercury are coal combustion, waste incineration, and metal processing. PCBs are another common cause of impairment. While the toxicity of individual PCBs depends on the specific form (or congener), this class of organic compounds contains endocrine disruptors, neurotoxins, and carcinogens. Like methylmercury, PCBs accumulate in fish tissues. The production of PCBs, used mainly as coolants and insulating fluids, was banned in the US in the late 1970s. However, PCBs are still quite ubiquitous, frequently appearing as "legacy contaminants" in soils close to where dischargers once used PCBs in industrial processes. These soils can then enter nearby water sources through stormwater runoff.

Table 4.2-2 Assessment Results for Rivers

Degree of Use Support	**Water Type**	**Total Miles** ***(Rounded to the Nearest Whole Number)***	**(%) Total**
Fully Support All Designated Uses **(EPA Category 1)**	River (mi.)	**26**	0.1%
Virginia Subcategory 1A		4	
Fully Support Some Uses but Insufficient Data to Assess All Uses **(EPA Category 2)**	River (mi.)	**5,321**	10.2%
Virginia Subcategory 2A		3,655	
Virginia Subcategory 2B		1,537	
Virginia Subcategory 2C		129	
Insufficient Data to Determine if any Uses are Being Met **(EPA Category 3)**	River (mi.)	**33,763**	64.6%
Virginia Subcategory 3A		33,020	
Virginia Subcategory 3B		292	
Virginia Subcategory 3C		247	
Virginia Subcategory 3D		204	
Waters are Impaired or Threatened but do not need a TMDL **(EPA Category 4)**	River (mi.)	**5,268**	10%
EPA Subcategory 4A		4,631	
EPA Subcategory 4B		6	
EPA Subcategory 4C		631	
Waters are Impaired or Threatened and need a TMDL **(EPA Category 5)**	River (mi.)	**7,877**	15.1%
Virginia Subcategory 5A		5,603	
Virginia Subcategory 5B		0	
Virginia Subcategory 5C		538	
Virginia Subcategory 5D		1,656	
Virginia Subcategory 5E		0	
Virginia Subcategory 5F		80	

Degree of Use Support	Water Type	Total Miles *(Rounded to the Nearest Whole Number)*	(%) Total
Total Size	River (mi.)	**52,255**	100%

Table 4.2-3 Assessment Results for Significant Lakes/Reservoirs

Degree of Use Support	Water Type	Total Acres *(Rounded to the Nearest Whole Number)*	(%) Total
Fully Support All Designated Uses **(EPA Category 1)**	Lakes (acres)	**12**	0.0%
Virginia Subcategory 1A		0	
Fully Support Some Uses but Insufficient Data to Assess All Uses **(EPA Category 2)**	Lakes (acres)	**19,626**	16.9%
Virginia Subcategory 2A		6,581	
Virginia Subcategory 2B		13,045	
Virginia Subcategory 2C		0	
Insufficient Data to Determine if any Uses are Being Met **(EPA Category 3)**	Lakes (acres)	**2,686**	2.3%
Virginia Subcategory 3A		2,596	
Virginia Subcategory 3B		28	
Virginia Subcategory 3C		62	
Virginia Subcategory 3D		0	
Waters are Impaired or Threatened but do not need a TMDL **(EPA Category 4)**	Lakes (acres)	**3,461**	3%
EPA Subcategory 4A		339	
EPA Subcategory 4B		2,644	
EPA Subcategory 4C		478	
Waters are Impaired or Threatened and need a TMDL **(EPA Category 5)**	Lakes (acres)	**90,580**	77.8%
Virginia Subcategory 5A		88,925	
Virginia Subcategory 5B		0	
Virginia Subcategory 5C		543	
Virginia Subcategory 5D		1,112	
Virginia Subcategory 5E		0	
Virginia Subcategory 5F		0	
Total Size	Lakes (acres)	**116,364**	100%

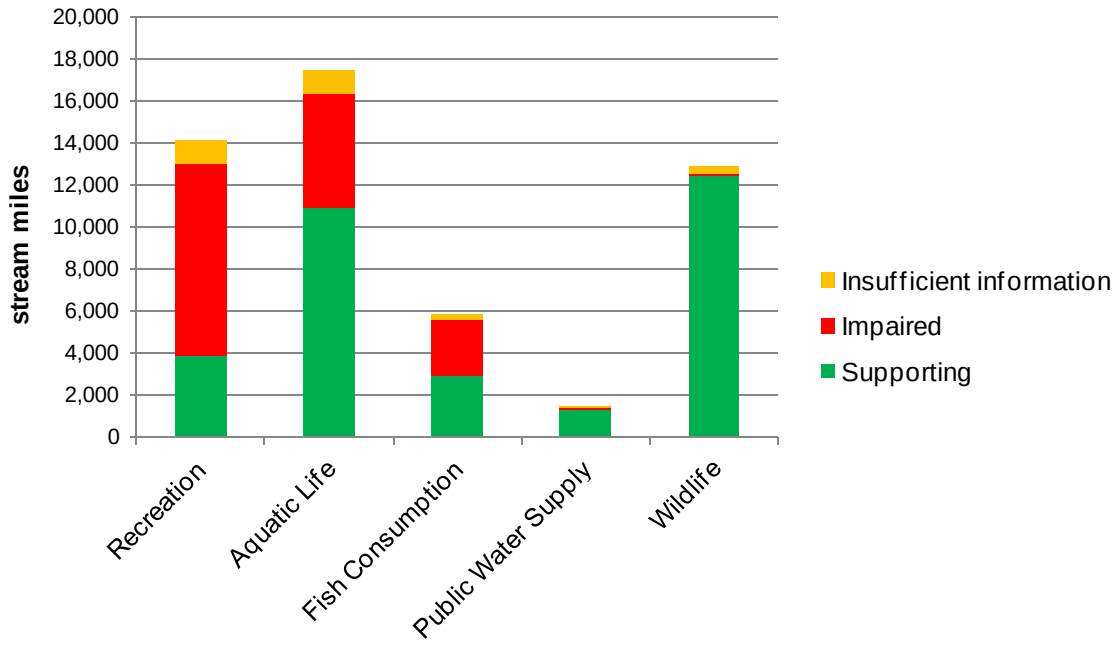
Table 4.2-4 Assessment Results for Estuarine Waters

Degree of Use Support	**Water Type**	**Total Square Miles** ***(Rounded to the Nearest Whole Number)***	**(%) Total**
Fully Support All Designated Uses **(EPA Category 1)**	Estuary (sq. mi.)	0	0.0%
Virginia Subcategory 1A		0	
Fully Support Some Uses but Insufficient Data to Assess All Uses **(EPA Category 2)**	Estuary (sq. mi.)	**139**	5.2%
Virginia Subcategory 2A		101	
Virginia Subcategory 2B		27	
Virginia Subcategory 2C		11	
Insufficient Data to Determine if any Uses are Being Met **(EPA Category 3)**	Estuary (sq. mi.)	**416**	15.5%
Virginia Subcategory 3A		1	
Virginia Subcategory 3B		415	
Virginia Subcategory 3C		0	
Virginia Subcategory 3D		0	
Waters are Impaired or Threatened but do not need a TMDL **(EPA Category 4)**	Estuary (sq. mi.)	**78**	2.9%
EPA Subcategory 4A		78	
EPA Subcategory 4B		0	
EPA Subcategory 4C		0	
Waters are Impaired or Threatened and need a TMDL **(EPA Category 5)**	Estuary (sq. mi.)	**2,050**	76.4%
Virginia Subcategory 5A		27	
Virginia Subcategory 5B		1	
Virginia Subcategory 5C		0	
Virginia Subcategory 5D		1,981	
Virginia Subcategory 5E		0	
Virginia Subcategory 5F		41	
Total Size	Estuary (sq. mi.)	**2,684**	100%

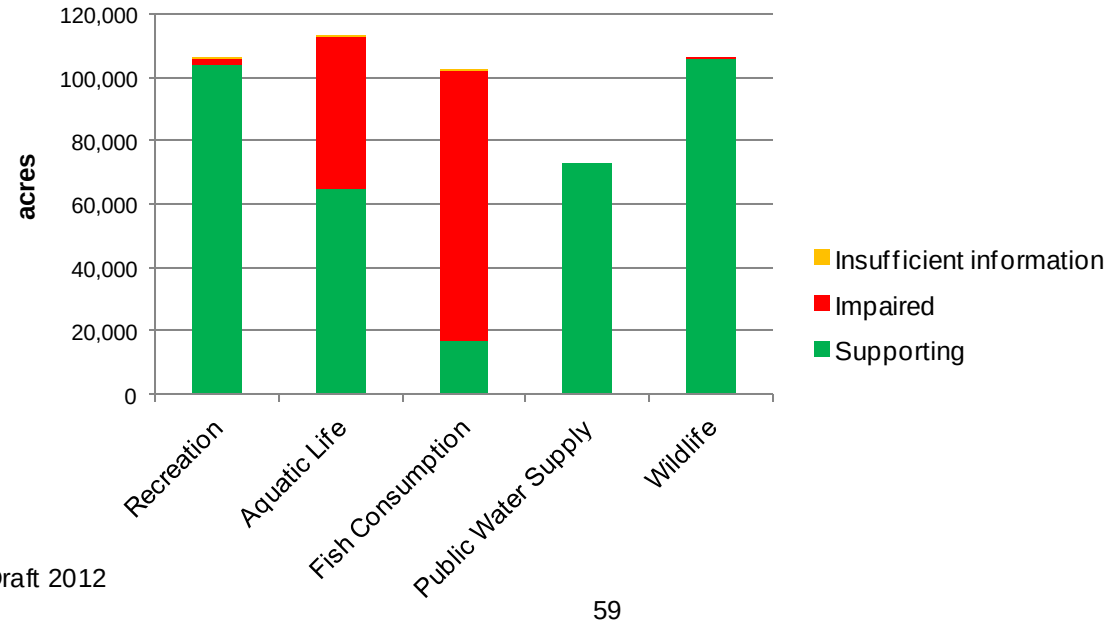
Figure 4.2-1 Designated use support summary. (Note: Waters that have some data, but not enough to determine use support, are classified as having "Insufficient information")

Size: ***All Sizes Rounded to the Nearest Whole Number***
Rivers - 52,255 miles
Lakes - 116,364 acres
Estuaries - 2,684 sq. miles

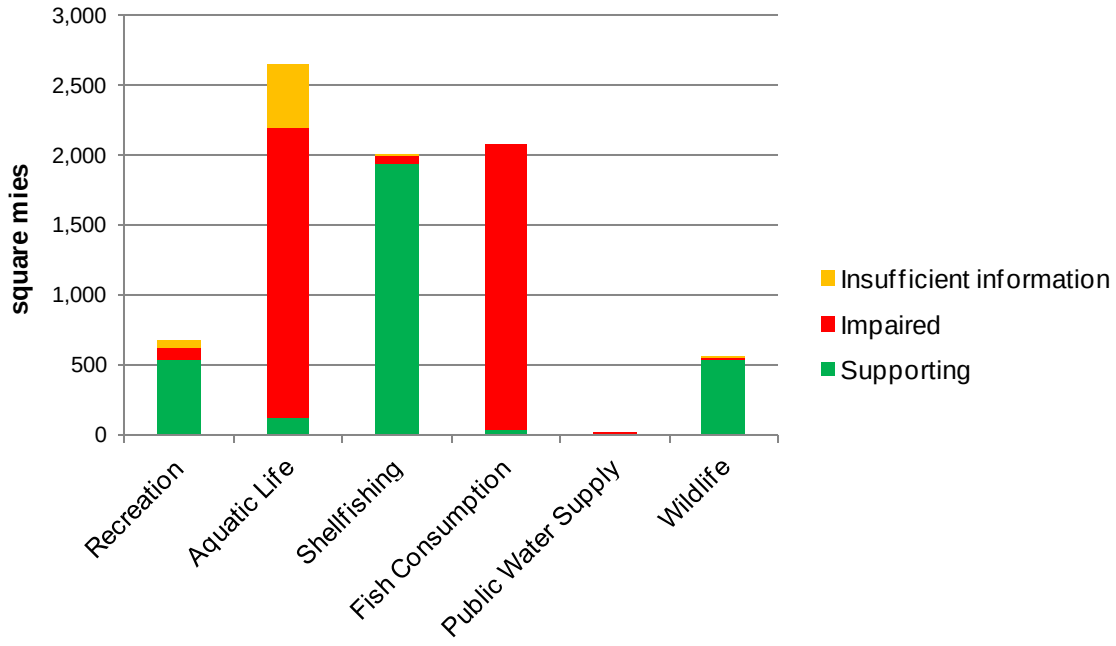
a) Rivers Assessment (33,763 miles were not assessed)



b) Lakes Assessment (2,686 acres were not assessed)



c) Estuaries assessment (416 sq miles were not assessed)



d) Assessment of Chesapeake Bay-specific designated uses (Migratory fish spawning and nursery use was not assessed.

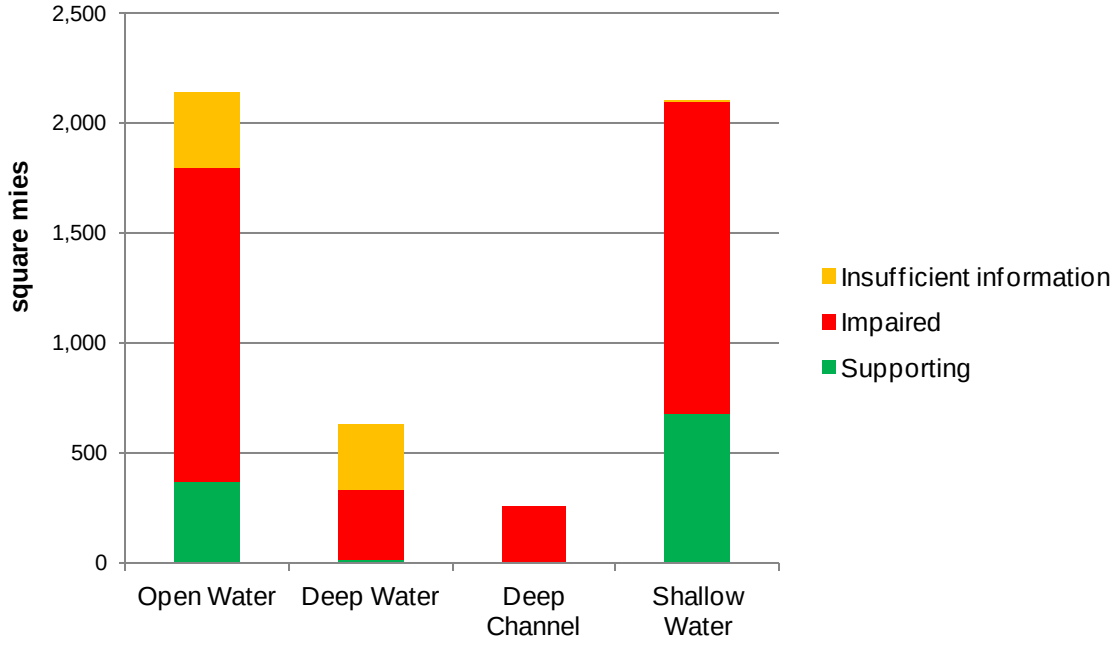


Table 4.2-5 Significant causes of designated use impairment, by waterbody type, ranked by percentage of impaired water size. (Note: Waters can have multiple pollutants.)

Rivers		*Lakes*		*Estuaries*	
Bacteria	50%	**PCBs in Fish Tissue**	66%	**PCBs in Fish Tissue**	91%
Benthics	14%	**Mercury in Fish Tissue**	49%	**Dissolved Oxygen**	75%
Dissolved Oxygen	11%	**Dissolved Oxygen**	38%	**Aquatic Plants**	63%
Mercury in Fish Tissue	11%	**pH**	4%	**Benthics**	34%
PCBs in Fish Tissue	6%	**Total Phosphorous**	3%	**Chlorophyll a**	9%
pH	5%	**Bacteria**	1%	**Bacteria**	5%

Table 4.2-6 Suspected sources of designated use impairment, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

Rivers		*Lakes*		*Estuaries*	
Source Unknown	28%	**Source Unknown**	80%	**Source Unknown**	90%
Wildlife other than Waterfowl	27%	**Natural Conditions**	32%	**Industrial Point Source Discharges**	90%
Livestock Grazing or Feeding Operations	18%	**Atmospheric Deposition (Toxics)**	3%	**Internal Nutrient Recycling**	87%
Non-Point Sources	18%	**Dam or Impoundments**	2%	**Loss of Riparian Habitat**	87%
Unspecified Domestic Waste	13%	**Wildlife other than Waterfowl**	1%	**Atmospheric Deposition (Nitrogen)**	87%
Natural Conditions	12%	**Unspecified Domestic Waste**	1%	**Agriculture**	87%